

WE CLAIM:

1. A method for forming a MOS transistor gate dielectric layer comprising:

providing a semiconductor substrate;

forming an oxide layer on the semiconductor substrate;

exposing the oxide layer to a high-density nitrogen plasma to incorporate nitrogen into the oxide layer thereby converting the oxide layer to an oxynitride layer; and

annealing said oxynitride layer in N_2O to form an oxynitride layer with a uniform nitrogen concentration profile.

2. The method of claim 1 wherein the exposing the oxide layer to a high-density nitrogen plasma comprises a plasma power level of 700 - 900 watts.

3. The method of claim 1 wherein annealing the oxynitride layer in N_2O comprises rapid thermal annealing at a temperature of $800^{\circ}C$ - $1100^{\circ}C$ for 10-60 seconds.

4. A method of forming a MOS transistor comprising:

5 providing a semiconductor substrate;

 forming a gate dielectric layer on the
 semiconductor substrate wherein the gate
 dielectric layer has a uniform nitrogen
10 concentration;

 forming a conductive layer on said gate
 dielectric layer,

15 forming sidewall structures adjacent to said
 conductive layer; and

 forming source and drain regions in the
 semiconductor substrate adjacent to said sidewall
20 structures.

5. The method of claim 4 wherein said forming a gate
dielectric layer with a uniform nitrogen concentration
comprises:

25 forming an oxide layer on the semiconductor
 substrate;

 exposing the oxide layer to a high-density
30 nitrogen plasma to incorporate nitrogen into the
 oxide layer thereby converting the oxide layer to
 an oxynitride layer; and

annealing said oxynitride layer in N_2O to form an oxynitride layer with a uniform nitrogen concentration profile.

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6. The method of claim 5 wherein the exposing the oxide layer to a high-density nitrogen plasma comprises a plasma power level of 700 - 900 watts.

10 7. The method of claim 5 wherein annealing the oxynitride layer in N_2O comprises rapid thermal annealing at a temperature of $800^{\circ}C$ - $1100^{\circ}C$ for 10-60 seconds.

15 8. The method of claim 4 wherein said uniform nitrogen concentration is greater than 6 atomic percent.

9. The method of claim 4 wherein gate dielectric layer is less than 40 angstroms thick.

20 10. The method of claim 4 wherein said uniform nitrogen concentration describes a nitrogen concentration with less than 10% variation across the gate dielectric layer.

11. A MOS transistor, comprising:

providing a silicon substrate;

5 a gate dielectric layer on the silicon substrate
wherein the gate dielectric layer is less than 40
angstroms thick and wherein the gate dielectric
layer has a uniform nitrogen concentration;

10 a conductive layer on the gate dielectric layer;

sidewall structures adjacent to said conductive
layer; and

15 source and drain regions in the silicon substrate
adjacent to the sidewall structures.

12. The MOS transistor of claim 10 wherein the uniform
nitrogen concentration is greater than 6 atomic percent.

13. The MOS transistor of claim 12 wherein the uniform
nitrogen concentration has a variation of less than 10%
across the gate dielectric layer.